

INTERNATIONAL PRELIMINARY EXAMINATION REPORT  
(PCT Article 36 and Rule 70)

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Applicant's or agent's file reference	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/GB 03/02950	International filing date (day/month/year) 07.07.2003	Priority date (day/month/year) 08.07.2002
International Patent Classification (IPC) or both national classification and IPC C09K15/02		
Applicant IMPERIAL COLLEGE INNOVATIONS LIMITED et al.		

- This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
- This REPORT consists of a total of 5 sheets, including this cover sheet.  
  
☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).  
  
 These annexes consist of a total of 4 sheets.

- This report contains indications relating to the following items:
  - I ☒ Basis of the opinion
  - II ☐ Priority
  - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
  - IV ☐ Lack of unity of invention
  - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
  - VI ☐ Certain documents cited
  - VII ☐ Certain defects in the international application
  - VIII ☐ Certain observations on the international application

Date of submission of the demand  09.02.2004	Date of completion of this report  08.11.2004
Name and mailing address of the international preliminary examining authority:   European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer  Pollio, M  Telephone No. +49 89 2399-8314



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. **PCT/GB 03/02950**

**I. Basis of the report**

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

**Description, Pages**

1-21 as originally filed

**Claims, Numbers**

1-35 received on 08.10.2004 with letter of 06.10.2004

**Drawings, Sheets**

1-4 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
  - ☐ the language of publication of the international application (under Rule 48.3(b)).
  - ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).
3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:
- ☐ contained in the international application in written form.
  - ☐ filed together with the international application in computer readable form.
  - ☐ furnished subsequently to this Authority in written form.
  - ☐ furnished subsequently to this Authority in computer readable form.
  - ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
  - ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.
4. The amendments have resulted in the cancellation of:
- ☐ the description, pages:
  - ☐ the claims, Nos.:
  - ☐ the drawings, sheets:

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5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Yes: Claims	1-35
	No: Claims	
Inventive step (IS)	Yes: Claims	1-35
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-35
	No: Claims	

2. Citations and explanations

**see separate sheet**

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**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial  
applicability; citations and explanations supporting such statement**

Reference is made to the following documents:

- D1: PATENT ABSTRACTS OF JAPAN vol. 2000, no. 03, 30 March 2000 (2000-03-30) & JP 11 343210 A (SHINSHU CERAMICS:KK), 14 December 1999 (1999-12-14)
- D2: DATABASE CA [Online] CHEMICAL ABSTRACTS SERVICE, COLUMBUS, OHIO, US; OGATA, SHIRO: "Antimicrobial adhesive sheets for application to diseased area for infection prevention or for packaging medical instruments for contamination prevention" XP002257414 retrieved from STN Database accession no. 128:80016
- D3: PATENT ABSTRACTS OF JAPAN vol. 017, no. 292 (E-1376), 4 June 1993 (1993-06-04) & JP 05 021630 A (KYOCERA CORP), 29 January 1993 (1993-01-29)

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1.1) The document D1 (see abstract) discloses a printing ink suitable for packagings and comprising a photoconductor powder. The presence of the powder is deemed to the mineralization of organic species and not to oxygen scavenging. The presence of an electron donor (as defined by claims 4-9 of the present application) is not explicitly disclosed in D1.

1.2) The document D2 (see abstract) discloses an antimicrobial adhesive sheet suitable for packagings and comprising a photoconductor powder. The presence of the powder is deemed to the mineralization of organic species and not to oxygen scavenging. The presence of an electron donor (as defined by claims 4-9 of the present application) is not explicitly disclosed in D2.

1.3) The document D3 (see abstract) discloses a closed package for a semiconductor. The sealing glass member comprises photoconductor components (zinc oxide, titanium oxide, vanadium oxide). The presence of an electron donor (as defined by claims 4-9 of the present application) is not explicitly disclosed in D3.

2.1) None of D1 to D3 suggests to combine an electron donor to a photoactivatable semiconductor in order to scavenge oxygen inside a closed package. Therefore the

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subject matter of claims 1 and 35 appears to involve an inventive step.

3.1) It is remarked that the expression "sacrificial electron donor" is unclear and not common in the art. A man skilled in the art can select a "sacrificial electron donor" immediately and unambiguously only in view of claims 4 - 9.

**CLAIMS**

1. A package packaging an item and defining a closed environment in which the item is enclosed, the packaging including an oxygen-scavenging element which includes a photo-activatable semiconductor and an electron donor, wherein the semiconductor, whilst exposed to ultra-bandgap light, generates electron-hole pairs, with the electrons acting to reduce oxygen, and thereby scavenge the same from the closed environment, and the holes combining with electrons sacrificed by the electron donor.
2. The package of claim 1, wherein the electron donor comprises an organic material.
3. The package of claim 2, wherein the organic material comprises a polymeric material.
4. The package of claim 3, wherein the polymeric material comprises PVA, PVC, PEG, polyethylene oxide, hydroxyethyl cellulose, or a mixture thereof.
5. The package of claim 2, wherein the organic material comprises an amine.
6. The package of claim 5, wherein the amine comprises EDTA, triethylamine, or a mixture thereof.
7. The package of claim 2, wherein the organic material comprises an alcohol.
8. The package of claim 2, wherein the organic material comprises a thiol.
9. The package of claim 2, wherein the organic material comprises an aldehyde.
10. The package of any of claims 1 to 9, wherein the electron donor comprises a liquid.

11. The package of any of claims 1 to 9, wherein the electron donor comprises a solid.
- 5 12. The package of any of claims 1 to 9, wherein the electron donor comprises a gas.
13. The package of any of claims 1 to 9, wherein the electron donor comprises a vapor.
- 10 14. The package of any of claims 1 to 13, wherein the semiconductor comprises an oxide semiconductor.
15. The package of claim 14, wherein the semiconductor comprises  $\text{TiO}_2$ .
- 15 16. The package of claim 14, wherein the semiconductor comprises  $\text{ZnO}$ .
17. The package of claim 14, wherein the semiconductor comprises  $\text{WO}_3$ .
18. The package of claim 14, wherein the semiconductor comprises at least two of  
20  $\text{TiO}_2$ ,  $\text{ZnO}$  and  $\text{WO}_3$ .
19. The package of any of claims 1 to 18, wherein the oxygen-scavenging element comprises a suspension containing the semiconductor.
- 25 20. The package of any of claims 1 to 18, wherein the oxygen-scavenging element comprises a paste containing the semiconductor.
21. The package of any of claims 1 to 18, wherein the oxygen-scavenging element comprises a gel containing the semiconductor.
- 30 22. The package of any of claims 1 to 18, wherein the oxygen-scavenging element comprises a solid containing the semiconductor.

23. The package of claim 22, wherein the oxygen-scavenging element comprises a block containing an activatable semiconductor.
- 5 24. The package of claim 22, wherein the oxygen-scavenging element comprises a layer containing an activatable semiconductor.
25. The package of claim 22, wherein the oxygen-scavenging element comprises a powder containing an activatable semiconductor.
- 10 26. The package of any of claims 1 to 25, wherein the oxygen-scavenging element comprises an encapsulating layer encapsulating at least a surface of the item.
27. The package of any of claims 1 to 25, wherein the packaging comprises a film  
15 packaging defined at least in part by the oxygen-scavenging element.
28. The package of any of claims 1 to 25, wherein the packaging includes an open-topped container and the oxygen-scavenging element comprises a film which closes the container.
- 20 29. The package of any of claims 1 to 25, wherein the packaging includes a closed container and the oxygen-scavenging element is disposed within the container.
30. The package of any of claims 1 to 29, wherein the item comprises an electronic  
25 device.
31. The package of any of claims 1 to 29, wherein the item comprises an opto-electronic device.
- 30 32. The package of claim 30 or 31, wherein the item comprises a molecular device.
33. The package of claim 30 or 31, wherein the item comprises a polymeric device.



34. The package of any of claims 1 to 29, wherein the item comprises a foodstuff.
- 5 35. Use of an oxygen-scavenging element including a photo-activatable semiconductor and an electron donor in a package, which packages an item and defines a closed environment in which the item is enclosed, to scavenge oxygen from the closed environment whilst exposed to ultra-bandgap light.